

**CONTINUING APPLICATION TRANSMITTAL UNDER RULE 1.53(b)  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Customer No. 004372  
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Docket No. 107242-09013

Date: November 14, 2001

Commissioner for Patents  
Washington, D.C. 20231

Sir:

Transmitted herewith for filing under 37 C.F.R. §1.53(b) is a

☒ Continuation      ☐ Divisional      ☐ Continuation-in-Part

application of prior pending Application No. 09/462,097, filed November 14, 2001.

For (Title):                      QUARTZ GLASS CRUCIBLE FOR PULLING UP SILICON SINGLE CRYSTAL  
AND PRODUCTION METHOD THEREFOR

By (Inventors):                Tatsuhiro SATO; Shigeo MIZUNO; Yasuo OHAMA

1. ☐ A Declaration and Power of Attorney is attached. The attached Declaration and Power of Attorney is:
- ☒ a. A copy of the Declaration and Power of Attorney from the parent application. (Used with the same or fewer inventors and (a) a copy of the prior application or (b) a revised, reformatted or edited version of the prior application that does not contain new matter.)
- ☐ b. A new Declaration and Power of Attorney. (Used with the same, fewer or additional inventors and (a) a copy of the prior application, (b) a revised, reformatted or edited version of the prior application that does not contain new matter, or (c) a new specification.)

2. ☒ The filing fee is calculated below:

**CLAIMS IN THE APPLICATION**

FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	52 - 20	= 32
INDEP CLAIMS	6 - 3	= 3
<input checked="" type="checkbox"/> MULTIPLE DEPENDENT CLAIMS PRESENTED		

\* If the difference is less than zero, enter "0".

**SMALL ENTITY**

RATE	FEE
	\$ 370
x 9 =	\$
x 42 =	\$
+140 =	\$
TOTAL	\$

**OTHER THAN A  
SMALL ENTITY**

RATE	FEE
	\$ 740
x 18	\$ 576
x 84	\$ 252
+280	\$ 280
TOTAL	\$1,848

3. ☒ A Check in the amount of \$1,140 to cover the filing fee is attached. The Commissioner is hereby authorized to charge any other fees that may be required to complete this filing, or to credit any overpayment, to Deposit Account No. 01-2300.
4. ☐ Cancel claims          of the application before calculating the filing fee. At least one independent claim is retained for filing purposes.
5. ☒ Amend the specification by inserting before the first line the sentence: -This is a Continuation of Application No. 09/462,097 filed January 12, 2000. The disclosure of the prior application(s) is hereby incorporated by reference herein in its entirety.--
6. ☒ Formal drawings (Figs. 1-8) are attached.

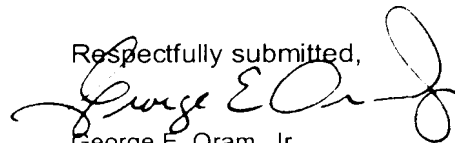
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J1131 U.S. PTO

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J0971 U.S. PTO  
09/987463  
11/14/01

7. ☒ Priority of foreign application Nos. 10-159880 filed May 25, 1998; and 11-022628, filed January 29, 1999 both in JAPAN are claimed under 35 U.S.C. §119 and/or §365(b).
8. ☒ Certified copies were filed in prior Application No. 09/462,097 on January 12, 2000.
9. ☐ A certified copy of the above foreign application(s) is attached.
10. ☐ Priority of U.S. Provisional Application(s) No. \_\_\_\_\_ filed \_\_\_\_\_ is claimed under 35 U.S.C. §119(e).
11. ☐ Amend the specification by inserting before the first line the sentence:  
--This nonprovisional application claims the benefit of U.S. Provisional Application(s) No. \_\_\_\_\_ filed \_\_\_\_\_.--
12. ☒ The prior application is assigned of record to Shin Etsu Quartz Products Co., Ltd., recorded at Reel 010612, Frames 0717 & 0718 on January 12, 2000.
13. ☐ This application is filed by fewer than all the inventors named in the prior application (37 C.F.R §1.53(b)(1)). Delete the following inventor(s) named in the prior application:
14. ☒ A Preliminary Statement is attached.
15. ☒ An Information Disclosure Statement is attached along with Form PTO-1449 and \_\_\_\_\_ references.
16. ☐ Small entity status:  
☐ a. A small entity statement is attached.  
☐ b. A small entity statement was filed in the parent application and such status is still proper and desired.  
☐ c. Small entity status is no longer claimed.
17. ☒ Other: Petition for Extension of Time; Change of Name and Address
18. ☐ The Power of Attorney in the application is to Robert B. Murray, Reg. No. 22,980; Charles M. Marmelstein, Reg. No. 25,895; George E. Oram, Jr., Reg. No. 27,931; Douglas H. Goldhush, Reg. No. 33,125; Richard J. Berman, Reg. No. 39,107; Murat Ozgu, Reg. No. 44,275; Robert K. Carpenter, Reg. No. 34,794; Gregory B. Kang, Reg. No. 45,273; Rustan Hill, Reg. No. 37,351; Hans J. Crosby, Reg. No. 44,634; Brian A. Tollefson, Reg. No. 46,338; David D. Dzara, Reg. No. 47,543; Lynne D. Anderson, Reg. No. 46,412; Michael A. Steinberg, Reg. No. 43,160 and Lynn A. Bristol, Reg. No. 48,898.
19. ☒ Address all future communications to:

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Respectfully submitted,



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

SATO et al.

Anticipated Art Unit: 1765

Application No. Unknown

Anticipated Examiner: R. Kunemund

Filed: November 14, 2001

Atty. Docket No. 107242-09013

For: QUARTZ GLASS CRUCIBLE FOR PULLING UP SILICON SINGLE CRYSTAL AND  
PRODUCTION METHOD THEREFOR

**PRELIMINARY REMARKS FOR CONTINUATION APPLICATION**

Assistant Commissioner for Patents  
Washington, D.C. 20231

November 14, 2001

Sir:

Prior to Examination of this Continuation Application, the Examiner is kindly requested to consider the following remarks. An Office Action dated June 14, 2001 was received in the parent application, Application No. 09/462,097. It was responded to by way of An Amendment under 37 C.F.R. 1.116 which was not entered. The claims of this continuation application have been prepared to place them in the identical posture as if the amendment had been entered and prosecution continued.

The Office Action rejected parent application claims 1-7 under 35 U.S.C. § 103(a) as unpatentable over Uchikawa et al. (EPO 319 013) in view of Matsumura et al. (EPO 463 543). The only current equivalent claims are claims 4 - 8 (parent 3 and 5 - 7).

Uchikawa teaches a quartz glass crucible that is used in a process for pulling a single crystal semiconductor material. The quartz glass crucible has an opaque outer substrate of a quartz glass with a relatively high bubble content and an inner transparent glass layer which is substantially free from bubbles. The crucible has a

substantially bubble-free transparent glass layer even after it is used for a pulling process.

Matsumura also teaches a quartz glass crucible that is used in the manufacture of a silicon single crystal. Matsumura further teaches that the quartz glass crucible has an outer layer which contains less than 0.3 ppm of each Na, K and Li and more than 5 ppm of Al. The outer layer also contains bubbles that present an opaque appearance. The inner layer is made by melting powders of high purity non-crystalline synthetic silica and contains less than 200 ppm of OH-group.

Claim 4 has been rewritten to depend from Claims 1 - 3 (parent newly-added claims 26-28).

The Office Action rejected parent claims 15-25 under 35 U.S.C. § 103(a) as unpatentable over Uchikawa in view of Matsumura and Sato et al. (U.S. Patent No. 5,989,021). The equivalent current claims are claims 8 -18.

Sato teaches a quartz crucible with a large inner diameter for pulling up a silicon single crystal.

Claims 8 -13 are rewritten to depend from claim 4 (parent claim 3).

Claims 14 - 18 (parent claims 21-23) are directed to a production method for a quartz glass crucible for pulling up a silicon single crystal. The quartz glass crucible has a diameter. With an arc rotation melting method, a base body is prepared in a mold using silicon dioxide powder and an inner layer is formed on an inner surface of the base body using silicon dioxide powder under conditions that the silicon dioxide powder has a particular gas content and an OH-group concentration equal to or less than 300 ppm, a heat melting power, a horizontal distance from an arc center to a falling position of the

silicon dioxide powder is in the range of 50-300  $\mu\text{m}$ . A distance from the arc center to an inner surface of piled-up powder on a bottom surface of the base is equal to or less than a particular distance, a particle diameter of the silicon dioxide powder is equal to or less than 300  $\mu\text{m}$ , and a feed rate of the silicon dioxide powder is equal to or less than 200 g/min.

In claims 14 and 15, the diameter of the quartz glass crucible is in a range of 22 to 28 inches. In claim 16, the diameter of the quartz glass crucible is in a range of 30 to 48 inches.

In claims 14 and 16, the gas content is equal to or less than 30  $\mu\text{l/g}$  while in claim 15 the gas content is equal to less than 20  $\mu\text{l/g}$ .

In claim 14, the heat melting power is applied in a range of 400 to 1000 kw. In claim 15, the heat melting power is applied in a range of 200 to 400 kw. In claim 16, the heat melting power is applied in a range of 600 to 2000 kw.

In claims 14 and 15, the distance from the arc center to an inner surface of piled-up powder on a bottom of the base body is equal to or less than 800 mm. In claim 16, the distance from the arc center to an inner surface of piled-up powder on the bottom of the base body is equal to or less than 1500 mm.

It is respectfully submitted that none of the applied art, alone or in combination, teaches or suggests the features of claims 14 - 18. Specifically, none of the applied art teach or suggest a particular gas content, an OH-group concentration, a heat melting power, a horizontal distance from an arc center, a distance from an arc center to an inner surface of piled-up powder, a particle diameter of the silicon dioxide powder and a feed rate of the silicon dioxide powder. Thus, one of ordinary skill in the art would not be motivated to combine the features of the applied art. Assuming, *arguendo*, that one of

ordinary skill in the art would be motivated to combine the features of the applied art, such combination of features of the applied art would not result in the claimed invention.

It is respectfully submitted that Claims 1 - 3 (parent newly-added claims 26-28) also include features not shown in the applied art. In brief, these claims incorporate the features of parent claims 5-7 into parent claim 1 to yield three independent claims.

Claims 1 - 3 are directed to a quartz glass crucible for pulling up a silicon single crystal.

The quartz glass crucible of these claims include a crucible base body constituted of a semi-transparent quartz glass layer and a transparent quartz glass layer formed on an inner wall surface of the crucible base body characterized in that no expanded bubbles equal to or more than 0.5 mm in diameter are present in a layer 1 mm in depth from an inner surface of the quartz glass crucible after the silicon single crystal is pulled up using the quartz glass crucible. With an arc rotation melting method, the base body is prepared in a mold using a silicon dioxide powder and an inner layer is formed on an inner surface of the base body using silicon dioxide powder under conditions that the silicon dioxide powder has a particular gas content and an OH-group concentration equal to or less than 300 ppm, a heat melting power of a specific range, a horizontal distance from an arc center to a falling position of the silicon dioxide powder in range of 50 to 300 mm, a distance from the arc center to an inner surface of piled-up powder on a bottom of the base body is equal to a set number of millimeters, a particle diameter of the silicon dioxide powder is equal to or less than 300  $\mu\text{m}$  and a feed rate of the silicon dioxide powder is equal to or less than 200 g/min.

In claims 1 and 3, the gas content is equal to or less than 300  $\mu\text{l/g}$  while in claim 2 the gas content is equal to or less than 20  $\mu\text{l/g}$ . The heat melting power is applied in

a range of 400 to 1000 kw in claims 1 and 2; while in claim 3 the heat melt power is applied in a range of 600 to 2000 kw. In claims 1 and 2, the distance from the arc center to an inner surface of the piled-up powder on a bottom of the base body is equal to or less than 800 mm while in claim 3, the distance is equal to or less than 1500 mm.

It is respectfully submitted, although Uchikawa states "substantially free from bubbles", bubbles actually exist even after the crucible is used for the pulling up process.

Neither Uchikawa nor Matsumura clearly teach a condition of bubbles at the inside of the crucible after pulling up. The claimed invention basically is focused on "bubbles expansion" at the inside of a crucible after the crucible is used for the pulling up process. Bubble expansion cannot be determined by only size and temperature. When an equilibrium value of a pressure from the outside (quartz glass), molecular weight, activation energy and so on exceed a critical value, bubbles expand. However, bubbles shrink when they are below a critical value.

Moreover, selection of a gas content significantly influences bubble expansion. Some gas is likely to gasify by the reaction with quartz glass while some gas is soluble to liquid phase quartz glass. For example, carbon reacts with quartz glass to form a gas such as CO. On the other hand, gas such as oxygen, chlorine or the like, since their solubility is low and their molecular diameter is large, will hardly diffuse into quartz glass, so that bubbles are expanded. If OH is concentrated at a high level in material powder, since the amount of oxygen increases as a result of the reaction, it causes bubbles.

Indeed, from the above point of view, the claimed invention which defined the

content and kind of gas can be clearly distinguishable from Uchikawa et al. which defined only the number and size of bubbles because these inventions were made from a technically different point of view. Matsumura also does not teach any gas content. The present specification is the very first one which recites the data regarding the gas content at the transparent inside layer.

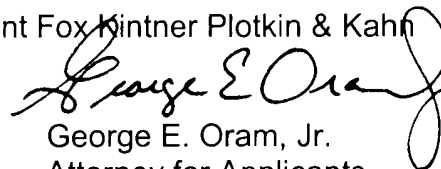
Consequently, for all of the above reasons, the claimed invention would not have been obvious to a person of ordinary skill in the art at the time the invention was made.

In view of the foregoing, consideration of this continuation application and allowance of the pending claims are respectfully solicited. Should the Examiner believe anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicant's representative at the telephone number listed below.

In the event this paper is not being timely filed, the applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 01-2300.

Respectfully submitted,

Arent Fox Kintner Plotkin & Kahn



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

SATO et al.

Art Unit: 1765

Application No.: Continuation of 09/462,097

Examiner: R. Kunemund

Filed: November 14, 2001

Atty. Dkt. No.: 107242-09013

For: QUARTZ GLASS CRUCIBLE FOR PULLING UP SILICON SINGLE CRYSTAL  
AND PRODUCTION METHOD THEREFOR

**NOTIFICATION OF CHANGE OF NAME AND ADDRESS**

Commissioner for Patents  
Washington, D.C. 20231

November 14, 2001

Sir:

Kindly change the correspondence name and address for the above-identified application to the following:

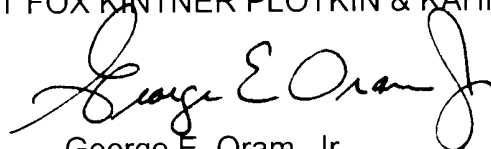
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Should any fees be due with respect to this paper, please charge Counsel's Deposit

Account No. 01-2300.

Respectfully submitted,

ARENT FOX KINTNER PLOTKIN & KAHN PLLC



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